MATH 423: PARTIAL DIFFERENTIAL EQUATIONS, FALL 2012

Instructor:	Betul Orcan-Ekmekci	**Time:** TTh	09:25-10:40 AM
Office:	420 Herman Brown Hall	**Classroom:**	HBH 423
Email:	orcan@rice.edu	**Office Hours:**	By Appointment

Class Webpage: Look for `MATH 423 F12` on Owlspace

Course Description: In this course, we will study the mathematical theory of many important classes of boundary value and initial value problems for Partial Differential Equations (PDEs), with emphasis on nonlinear equations. We will start with the analysis of four important linear PDEs, namely, transport equation, Laplace's equation, heat equation, and wave equation. The second part of the course will focus on nonlinear first order PDEs. Their conservation laws will be introduced and their representation theory in terms of Fourier transform will be studied. Moreover, as another important example, we will analyze Hamilton-Jacobi equations. In the last part of the course, we will introduce Hilbert and Sobolev spaces and study the theory of second order elliptic and linear evolution equations.

Prerequisites : (CAAM 401 and 402) or (MATH 222) or (MATH 212 and 321) or equivalent.

Textbook: Lawrence C. Evans , Partial Differential Equations, Methods and Applications, American Math. Soc. Graduate studies vol.19. In this course, we plan to cover up to chapter 8 of this book.

Homework and Exams:

- There will be a homework assignment each week usually due each Tuesday. The homework is not pledged. You are encouraged to discuss the homework, and to work together on the problems. However each student is responsible for the final preparation of his/her own homework papers.
- Midterm Exam: A take-home exam will be distributed on a Thursday and collected by next coming Tuesday. It should be taken over a continuous 3 hour period with textbooks and notes allowed.
- Final Exam will similarly be a take-home exam. It should be taken over a continuous 4 hour period with textbooks and notes allowed.

Expectations: I expect you to attend every class and to arrive on time. It is your responsibility to keep informed of any announcements, syllabus adjustments, or policy changes made during scheduled classes. Not all announcements will be posted on the website.

Disability Support: Any student with a documented disability seeking academic adjustments or accommodations is requested to speak with me during the first two weeks of class. All such discussions will remain as confidential as possible. Students with disabilities will need to also contact Disability Support Services in the Allen Center.

Tentative Schedule:

- Section 1. Basic notions of functional analysis, basic Lp space theory, important inequalities, and convolution and mollifiers. (2 Classes)
- Section 2. Laplace equation. Fundamental solution. Properties of Harmonic functions. Poisson equation. (3 Classes)
- Section 3. Heat equation. Fundamental solution. Mean-value formulas and energy methods. (3 Classes)
- Section 4. Wave equation. Solution by spherical means. Energy methods. (3 Classes)
- Section 5. Transport equation and First-order Nonlinear PDEs The method of characteristics. (3 Classes)
  - Section 6. Analysis of Hamilton Jacobi Equations, some special cases. (3 Classes)
  - Section 7. Similarity under scaling as other ways for presentation of solutions. (1 Class)
  - Section 8. Homogenization in asymptotics (1 Class)
- Section 9.Distribution and fundamental solutions of linear equations. (2 Classes)
- Section 10. Hilbert and Sobolev spaces (3 Classes)
- Section 11. Fourier methods with applications to the Fractional Laplacian and Schrödinger equation. (2 Classes)
- Section 12. Analysis of 2nd order Elliptic Equations (2 Classes)
- Section 13.Analysis of 2nd order parabolic equations. (2 Classes)